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THE JOURNAL OF PHILOSOPHY

PSYCHOLOGY AND SCIENTIFIC METHODS

THE EMPIRICAL CORRELATION OF MENTAL AND BODILY PHENOMENA

SINCE the days when Descartes placed the soul in the pineal gland to deflect at will the course of the animal spirits and his successors formulated in return the elusive dogma of parallelism, mankind's conceptions of the soul and its relation to the body have remained fundamentally unchanged. The modern substitute for the Cartesian view is framed, it is true, in the light of a riper knowledge of the physiological structure of brain and nerve; but the difference between a soul which controls the mechanical action of the brain through a pineal gland and one which operates more obscurely at the synapses, raising and lowering the resistance to nervous discharge to effect its purposes, is not a fundamental one. Nor, on the other hand, has the advance in science essentially altered the conception of parallelism. Upon the familiar and dreary round of argument and counter-argument through which the long controversy between interactionism and parallelism has worn itself out, we shall not enter. The issue is not decided but it is no longer a living one. A growing sense of its futility has come upon us. It has survived so long because the only alternative to the conception of mind as a being or activity distinct from the body which has seemed possible has been the identification of the mental with the physical. In the last few years, however, changed perspectives have brought into fresh relief the unsurmounted, and, I venture to say, unsurmountable difficulties which oppose the belief in a transcendent soul, or a conscious existence *sui generis*. The conviction has gained ground among us that such a belief is a survival of older modes of thought, in other fields happily outgrown. But to cherish this conviction is to face the task of finding new terms in which to read the empirical facts which the older conception imperfectly embodied. The newer movements of our own day, pragmatism, neo-realism, behaviorism, have all been, in part at least, motivated by the need for such philosophic and scientific reformulation. And amid all the confusion of present-day controversy there is to be discerned, we believe, a meas-

ure of common achievement, not yet consummated, nor capable of precise definition, but the foundation for an intellectual advance as momentous possibly as that marked by the philosophy of Descartes.

It is the purpose of this paper to examine how psychological phenomena such as emotion and perception are empirically correlated with the functioning of the nervous system. The alternatives with which we are familiar are either that for every change in conscious experience there is to be found a corresponding change in the chemical and physical processes taking place in the cerebrum; or else, that while many of the simpler conscious processes may be initiated by cerebral changes and in turn modify such changes, no general or complete correlation is to be made out between conscious experience and nervous action. These alternatives are not, as I shall try to show, exhaustive, nor is either of them an adequate description of the empirical facts. What they both falsely presuppose is that, if there is any systematic correlation between conscious experience and the functioning of the nervous system, it must be between psychical processes and the physical or chemical changes taking place in the brain. Or, in other words, it is taken for granted that the nervous system is adequately describable as a physiological organ and its functioning as a complex set of physical processes.

We find this point of view most clearly expressed in such nineteenth-century thinkers as Huxley or Tyndall. Both scientific investigators of the first rank, they were deeply impressed by the fact that research into the processes of organic matter reveals nothing but natural forces. Even the nervous impulse is nothing but chemical reaction. We do not, says Tyndall, possess the organ, nor the vestige of an organ, which enables us to pass from the mechanics of the brain to the corresponding feeling. Thus he was led to a parallelism which could point to a possible connection between a left-hand spiral motion and the emotion of love. This undoubtedly was a bit jocose, but it fairly represents the categories to which the speculation of his generation was limited. Bound to such limitations what, indeed, is left but an *Ignorabimus* before a final mystery?

It is in keeping with this mode of thought to speculate further as to the consequences of producing in a test tube the highly complex and unstable molecules of a brain cell and stimulating them to reactions identical to those occurring in the brain of a living being. Might there not at the same time be produced a throb of simple consciousness? If such speculations as these have not been often openly indulged in, it has been common sense and not theoretical insight which has prevented. Even so modern a writer as Münsterberg is able to postulate an ultimate conscious element, simpler than the sen-

sation, and corresponding to the reaction of a single cerebral cell as its compound, the sensation, corresponds to the reactions of a localized group of cells.

This view of Münsterberg's, however, may properly be said to represent an alternative interpretation of the correspondence theory. We may distinguish it from the *psycho-physical* parallelism of Tyndall, by the title *psycho-physiological* parallelism. According to this more cautious interpretation, the correlative of a specific mental process is not a geometrical figure of the dance of brain atoms, nor even necessarily a particular chemical reaction, but the occurrence of similar physiological processes in definite physiological structures. The classic doctrine of specific energy is an example in point, and indeed a large part of what goes under the head of physiological psychology belongs to this view of the mind-body relation. This form of parallelism offers certain advantages over the cruder *psycho-physical* formulation. It is less doctrinaire. It does not commit one to the extremes of kinetic mechanism; and it has far more regard for empirical facts. Theoretically, however, such a doctrine as that of specific energy leaves us face to face with as final a mystery as that which confronted Tyndall. And as I shall try to show it is not verified, nor verifiable, by available empirical evidence.

In a sense the contention of parallelism is acceptable. For every change in psychical processes there doubtless is a change in the processes going on in the cortex. But it is equally true that for every change in psychical processes there is a change in atmospheric currents. To make the concomitancy of psychical and cortical change a significant *correspondence*, which is what parallelism claims, it is necessary to establish that the characteristic groupings, or *phenomena*, which the one presents are traceable in the other also, and that a repetition of a feature of the one matches a repetition of the corresponding feature of the other. What makes parallelism in whatever form so paradoxical a doctrine is the fact that it assumes the phenomena of nervous action to be individuated and determined by an entirely different set of principles from those by which the supposedly corresponding phenomena of conscious experience are individuated and determined. That there is a correspondence of some sort between the phenomena of conscious life and the functioning of the nervous system we should all admit. The question is: Of what nature is it? In what terms are the phenomena of nervous function which correspond to the phenomena of conscious life to be described? What the mind-body problem demands for its solution is the exhibition of a principle of individuation and classification common to the two. To accomplish this would in truth be not to solve the

problem but to show that its very formulation depends on untenable assumptions. For to show that two supposedly disparate systems of phenomena are individuated and classified by a common set of principles is to exhibit them not as two but as one single system of phenomena.

The clue of which we are in search lies, I believe, close at hand. It is to be found in the simple insight that the central nervous system is not primarily a physiological organ. Its function is only secondarily to maintain the inner equilibrium of bodily processes which constitutes the living as opposed to the dead being. Its primary function is the adjustment of the behavior of the individual as a whole to the outer world of goods and dangers which constitutes his environment. It is in the performance of this wider function that we must find the correlate of feeling and thought, rather than in the stimulation of neurone and ganglion. It is true that each act in the performance of this function is controlled by the stimulation of neurone and ganglion. But the uniformities of function, the characteristic *phenomena* which correspond to psychological uniformities are not describable in physiological terms.

This has been strikingly, although perhaps unintentionally illustrated for us by Professor John Watson in a recently published article, "On Behavior and the Concept of Mental Disease." A distinction is commonly made by alienists, so Professor Watson tells us, between such mental disorders as are conditioned by cortical lesions, or physiological disturbance of cortical function, and those for which no physiological cause can be assigned. These last are commonly called mental or "strictly mental" disease. Such a case might be, for example, an individual who ordinarily comported himself in conventional fashion, but whom religious service, instead of inspiring to appropriate devotional attitude and behavior, irresistibly impelled to the loud utterance of outrageous and ribald remarks. What Professor Watson urges is that such cases as these are not purely mental in the sense that there is no correlative misfunctioning of the central nervous system. Many such cases he describes as wrong "habit complexes." Now inappropriateness of habitual behavior is evidently not to be identified with physiological disturbance, although it is as evidently due to the failure of the cortex to function properly. If Professor Watson is right, it is evident—though he himself apparently does not draw the conclusion—that normal and abnormal functioning of the cerebral cortex may be distinguished, not on the basis of any determinable physiological differences, but by the relative appropriateness of the cerebrally controlled behavior to environmental—say even social—conditions.

The characteristic uniformities which the functioning of the cortex exhibits to our observation, and according to which it may be intelligently analyzed, are not, then, uniformities of organic process or muscular contraction. They are uniformities of *behavior* in a larger sense.

In the light of this conception let us turn to the examination of some of the simpler typical mental phenomena and their bodily correlates. We shall consider first the case of emotion, using *fear* as an example.

Research has so far failed to localize this and other emotions in the cortex or in the lower centers. Yet fear, like other primary emotions, has markedly characteristic bodily expressions. It manifests itself, in fact, in a variety of ways: in flight, in hiding, in shrinking, sometimes in "freezing," or a complete paralysis of all activity, even vocal utterance. Sometimes it impels the individual to seek the protection of some other individual, as the child flees to its mother's skirts; or, again, it inspires to frantic attacks on the inciting objects. All these characteristic responses are found in man; and to these we may add the "expressive" reactions—such physiological disturbances as pallor, trembling, increased heart-beat, excitation of the ductless glands, *etc.* If we include the species we find even greater variety of congenital and acquired responses. Now what is the common denominator of these varied modes of behavior? There must be considerable diversity in nervous activity to issue in such diversity of response. For not only are the characteristic responses different on different occasions; the stimuli which inspire fear congenitally, and as a result of simple experience, differ at least as widely. These widely differing stimuli, and the widely differing responses to which they lead, must be connected by a great diversity of central stimulation. Although various theories have been advanced, we can point to no cortical or sub-cortical "center" of fear, nor to any characteristic set of paths followed by the excitations set up by stimuli responded to as "fearful." And while recent researches have shown that an important part is played in emotional disturbance by the activity of the ductless glands, they have failed to discover in such physiological activity any specific correlate to a specific emotion. Yet these varied modes of response and the differing cortical action leading to them mediate a common experience—fear. What the various stimuli have in common is no set of similar physical characteristics. It is the *common relation* in which they all stand to the individual, the relation of being *dangerous*. Similarly the varied responses fall into a single group because of their common function in averting the threatened danger. The response

actually elicited on any particular occasion may, it is true, fail to avert the danger, but the normal function of such behavior remains the same. The variety of fear responses exhibited by a species are undoubtedly evolutionary modifications of much simpler reactions, possibly even the primitive avoiding reaction. But the modifications of reaction which have been selected in the race, as in the individual, have been selected and preserved because of their success in performing this function, just as the stimuli which evoke it are selected because of their dangerousness. Consequently we find civilized man not only persisting in the congenital and simpler types of reaction to danger, but acting in indefinitely varied and indirect modes as well.

It is their common ancestry and the community of function in the economy of life which serves to unite the varied responses into a single phenomenon. So, too, it is the identity of the part played in this economy by the differing cortical and sub-cortical processes exciting these responses that determines the identity of the correlated conscious experience. Even if research should discover a "fear center" to which all "fearful" stimuli are transmitted and whence all fear responses are indirectly excited, the case would not be essentially altered, for we should point to the stimulation of this center as the correlate of the emotion fear precisely because of its function in coordinating such responses to such stimuli.

We are now prepared to consider the case of perception. This is more complicated than emotion since perception covers so wide a range of phenomena, and since meaning is so largely involved. Thus we may *perceive* a total situation, a single object, a relation, or a quality. But in none of these cases, except possibly the last, have we grounds for supposing that "sameness" of perception is conditioned by sameness of physiological process. My perceptions of my dog on different occasions, since they are perceptions of this same familiar dog, are in so far alike. But the sensory excitations from eye and ear and hand, if compared on any two occasions, would probably be found to contain no single common factor, nor is there evident reason to suppose that the perception of my dog excites any invariable motor response. Perceptual experiences are commonly classed as like or different because of identity of meaning, rather than because of likeness of sensory content, and, as is well known, physiological psychology ventures to say very little concerning the physiological basis of meaning.

When we come to perception of simple sense-qualities, such as color, tone, odor, *etc.*, however, the case is very different. Such experiences seem to be classed, both by common sense and psychology,

wholly on the basis of immediately felt identities and differences, without any reference to meaning. And it is these psychological phenomena to which definitely localized cortical excitations correspond. Thus there is a well-defined visual center in the occipital lobe, *etc.* In short, perception of sense qualities is the field where the evidence for psycho-physiological, if not psycho-physical correlation is most convincing. In the phenomena of vision, in particular, research has established beyond dispute that specific physiological structures condition the experiencing of the different visual qualities. Various color theories, it is true, continue to dispute the field, but all unite in the unquestioned assumption that the experience of color qualities is mediated by the functioning of correspondingly different physiological structures. Take the case of "red," for example. Here, as in the case of other visual and auditory qualities as well, we find a definite physical correlate of the sense quality "red," *viz.*, specific wave-length. In order that a physical stimulus of this sort should excite the corresponding sensory quality, it must initiate a specific process in retinal end-organ, which must in turn set up processes in the cortical cells of the visual center. Now, according to the traditional view, the excitement of such specific processes in the visual center is the essential and sufficient condition for the experiencing of the quality "red." What we have to ask is whether this view adequately represents the relevant empirical facts, or whether it is a result of the same theoretical preconceptions which dominated the thought of Tyndall's generation. That the excitation of specific processes in the visual center is a necessary condition of experiencing "red," is, of course, to be admitted; but that such excitation constitutes the *essential* and *sufficient* condition is not, I submit, a conclusion warranted by empirical evidence, nor is it a conclusion which any available empirical evidence could suffice to establish. For what sort of empirical evidence is adducible? The evidence from behavior only. That an individual is or is not capable of experiencing a given sense quality can be determined only by his capacity to discriminate the quality by appropriate behavior. It is only on the basis of evidence from behavior that any conclusions as to the cerebral function can be drawn. Now the ability to discriminate a sense quality like red depends not simply upon the excitation of specific processes in the sensory center, but upon the existence of an extensive system of sensory and motor connections. For such a system of connections is implied in the very act of attention itself by which the quality is perceived. Consequently, what the empirical evidence points to as the neural correlate of the sensation "red," is not the occurrence of specific processes in the visual center, but the

functioning of that center as a member of a complicated system. To suppose that excitation of the visual cells could mediate the experience of sense quality red if their functional connections with other centers were interrupted, is to make an assumption for which no possible evidence is available and which must rank accordingly as futile speculation.

Let us turn to the consideration of the psychological correlates. It is often urged that the analysis and description of mental phenomena must be carried out in the last resort on the basis of introspection. "Fear" is something I first became acquainted with in my own experience, and afterwards learn to associate with its external manifestations. Red is a felt quality, knowable only in its immediacy. So all our feelings and sensations, if not our thoughts and beliefs, are something immediately and directly experienced, something whose intrinsic qualities are the private possession of each of us. I may, indeed, on the strength of the dubious argument from analogy, attribute to my fellow-beings the enjoyment of inner experiences like to mine. But all that is open to my observation is his like behavior. It *may* be true, since the argument from analogy falls so far short of proof, that your feeling of fear is more like my sadness, or my anger, than it is like the fear I feel, or it may be something altogether akin to my experience. This hidden feeling of yours, unknowable by me, is like mine, indeed, in that it leads you to actions such as mine excites in me, but this likeness is merely one of external relationships. Or, again, although we both agree in calling blood red, and finding it in this respect like strawberries or the alternate stripes on the American flag, and although we both place it similarly on the color pyramid, and agree in calling it warm and the color of passion, *etc.*, it may be that what you enjoy as "red" I enjoy as "blue," and that only in their relations are our two reds identical. Indeed, we may go further and suppose that the whole course of your experience as immediately enjoyed by you is utterly different in felt quality from mine. Such a supposition can not be refuted—nor can it be established—for the simple reason that it is beyond the reach of any argument whatsoever. It is an essentially unintelligible supposition concerning wholly unknowable things-in-themselves.

Mental phenomena, like any other phenomena, can be subjects of intelligent discourse only in so far as they are identified and described in significant terms. In what terms then can mental phenomena be significantly and intelligibly described and analyzed? If the examples which we have chosen from the fields of emotion and perception are typical, it is only by reference, direct or indirect, to

their function in securing the adjustment of the individual to his environment, physical and social. The fear which the psychologist studies is not a hidden feeling cherished within his breast; it is precisely *that* feeling which is inspired by determinate objective conditions, and which impels him to characteristic expressions and acts. He can identify a given experience to himself as "fear" only in so far as it sends cold shivers down his back, or gives him a sinking in the pit of his stomach or makes his knees shake beneath him. But even these private earmarks are phrases whose significance is set by common usage.

If the foregoing contentions are just, the conclusion we have to draw is that the mental and bodily phenomena whose empirical correlation sets us our problem are not phenomena belonging to two distinct orders of nature, but phenomena which actually are, and only can be, individuated and classified by common principles. Both the bodily correlates of mental processes, and the mental processes themselves, are individuated as phenomena only on the basis of their function in adjusting the individual to his environment.

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THE DIVISION OF JUDGMENTS

I

JUDGMENTS in logic are traditionally divided on the four bases of quantity, quality, relation, and modality, and this division has received so much support from the influence of Kant that it has persisted in our elementary manuals down to the present day. And yet, the whole movement of what is known as "modern logic" has been definitely in another direction. Lotze, for instance, rejects at least three fourths of the traditional scheme. He insists that judgment is an interpretation of observed fact, expressing not merely a relation between the matters of two ideas, but also the ground of this relation, and shows that this relation and its ground are expressed by means of the copula. It follows that judgments can be divided into as many different forms as there are different meanings of the copula—*i. e.*, different accessory notions which we form of the connection of *S* and *P*. Of such accessory notions we form three main types: (1) the categorical, which connects *S* and *P* on the model of the relation of a thing to its property, (2) the hypothetical, which connects *S* and *P* on the assumption that a certain condition is fulfilled, and (3) the disjunctive, which imposes upon *S* the necessity